Winter 2011

High Plains Herald

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The National Weather Service provides weather forecasts and warnings for the protection of life and property and the enhancement of the national economy.

Inside this Issue:

Why Talk About Winter Weather?

By John Griffith

Winter storms may not be as dramatic as the tornadoes and flash floods of the summer months but they can be just as deadly. Each year, dozens of Americans die due to exposure to cold. Add to that number, vehicle accidents and fatalities, fires due to dangerous use of heaters and other winter weather fatalities and you have a significant threat.

Threats, such as hypothermia and frostbite, can lead to loss of fingers and toes or cause permanent kidney, pancreas and liver injury and even death. You must prepare properly to avoid these extreme dangers. You also need to know what to do if you see symptoms of these threats.

A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall and cold temperatures. People can be trapped at home or in a car, without utilities or other assistance. Attempting to walk for help in a winter storm can be a deadly decision. The aftermath of a winter storm can have an impact on a community or region for days, weeks or even months. The cost of snow removal, repairing damages and the loss of business can have severe economic impacts on cities and towns.

Winter Weather Terms

The following are National Weather Service definitions of some winter weather terms.

Blizzard: Winds of 35 mph or more with snow and blowing snow reducing visibility to less than ¼ mile for at least 3 hours.

Blowing snow: Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.

Snow squalls: Brief, intense snow showers accompanied by strong, gusty winds. Accumulations may be significant.

Snow Showers: Snow falling at varying intensities for brief periods of time. Some accumulation is possible.

Snow flurries: Light snow falling for short durations with little or no accumulation.

Injuries Due to Ice and Snow

About 70 percent of injuries result from vehicle accidents.

About 25 percent of injuries occur in people caught out in a storm

Most injuries happen to males over 40 years old.

Injuries Related to Cold

About 50 percent of the injuries happen to people over 60 years old.

More than 75 percent of the injuries happen to males.

About 20 percent of the injuries occur in the home.

What to Listen For This Winter

The National Weather Service issues outlooks, watches, warnings and advisories for all winter weather hazards. Here's what they mean and what to do. Use the information below to make an informed decision on your risk and what actions should be taken. Remember to listen to your local officials' recommendations and to NOAA Weather Radio for the latest winter storm information.

Outlook: Winter storm conditions are possible in the next 2 to 5 days. Stay tuned to local media for updates.

Watch: Winter storm conditions are possible within the next 36 to 48 hour. Prepare now!

Warning: Life-threatening severe winter conditions have begun or will begin within 24 hours. Act now!

Advisory: Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If you are cautious, these situations should not be life threatening.

Stay Informed!

"...people used what they observed and related that to... ...weather."

Inside this Issue:

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Weather Lore

By Mike Weiland

Across the nation and world, people have noticed things about the weather and their surroundings for many years now. Before current weather forecasting came to be, people used what they observed and related that to current and upcoming weather. Our area is no exception to the interesting sayings about animal and natural activity related to upcoming weather. Much of the folklore is actually true and based on many years of observations and it is fun to discover some of the sayings.

The following are a few weather folklore sayings from Wyoming found in the book "Wyoming Folklore: Reminiscences, Folktales, Beliefs, Customs, and Folk Speech" written by James R. Dow and Susan D. Dow;

The earlier a coyote gets its winter coat, and the thicker it is, the longer and harder will be the winter.

When ground squirrels hole up earlier than normal, it will be a hard winter.

When flies and gnats bit viciously, it is a sure sign of a thunderstorm.

If it rains while the sun is shining, it will rain tomorrow.

An extremely bright red sunset means that the next day will be windy.

Snowfall vs. Snow Depth

What is the difference between snowfall and snow depth? They can be quite different. The snow depth is the depth of snow on the ground at a certain time. Sometimes, when it is relatively warm, the snow depth can be lower than the snowfall. And, there can be days where there is no snowfall, but snow remains on the ground. The snowfall is how much snow falls from the sky and not necessarily what accumulates on the ground.

Winter Sports Safety

By Jim Knutson

Thousands of people ski, snowboard and sled each year in Wyoming.

These cold weather activities can be exhilarating, but also result in many injuries every year.

You can reduce the chance of becoming one of these injuries by following a few safety tips.

Be sure you are in shape, before you hit the slopes

Take lessons, if you are new to the sport

Wear a helmet

Ensure you have the proper equipment and that it is fitted properly

Dress in layers

Be prepared for a change in the weather

Protect your skin from the sun and wind (sunscreen)

Always use appropriate eye protection

HAVE FUN AND ENJOY THE WINTER SPORTS SEASON!

The record 24 hour snow fall for the state of Wyoming is 34 inches from January 28, 1933 at the Belcher River Ranger Station. The coldest temperature recorded in Wyoming happened the same year. The Riverside Ranger Station recorded –66 F on February 9, 1933.

Classification of Winds in Southeast Wyoming

By Mike Jamski

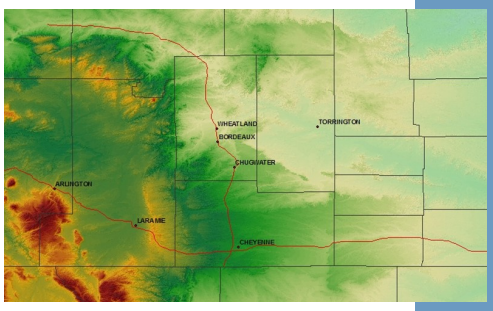
High winds are a common occurrence across the Rocky Mountains and adjacent High Plains from September through May, especially in southeast Wyoming. Occasionally, the western Nebraska Panhandle can be affected by strong winds. High winds often cause problems for commerce, with travel restrictions for semi-trucks and other high profile vehicles due to the potential for blow overs.

Meteorological patterns for high wind events in southeast Wyoming can be complex, with topography playing a significant role. Topography is a critical element in the location, frequency and intensity of high winds. The figure below is a topographic image of southeast Wyoming and surrounding areas, where the warmer colors represent higher elevations and cooler colors signify lower elevations. There are two mountain ranges, the Snowy Range over southeast Carbon and southwest Albany counties, and the Laramie Range from southern Converse County south into eastern Albany County. Average elevations of the Laramie Range vary from 7,000 to 10,000 feet mean sea level (MSL). East of the Laramie Range are the southeast Wyoming plains, dominated by the North Platte River which flows through Torrington. Elevations in the North Platte Valley drop to 4000 MSL. A ridge separates the North Platte Valley from the higher sloping terrain around Cheyenne and areas to the east.

There are three types of high winds in Wyoming: Chinook, bora and gap. The most common is the Chinook wind, or mountain wave wind. These winds occur when fast west to northwest winds in the upper levels of the atmosphere combine with a surface pressure trough over the High Plains. Chinook winds are downslope, warming winds which can reach speeds as high as 100 mph, especially along the Front Range in northern Colorado. The most likely location for Chinook winds in southeast Wyoming is western Laramie County, downwind of the southern Laramie Range. Visible features of mountain wave winds are rotor and altocumulus standing lenticular clouds near the crests of the waves. These winds typically occur at night and depending on other factors, can end by mid-morning or continue throughout the day.

Bora winds are less common and are caused by strong cold air advection near the surface, resulting in rapid surface pressure rises in the wake of a Pacific cold front. The onset of high winds occurs with the frontal passage, and can persist for several hours thereafter. One recent bora wind event was December 31, 2011, which produced widespread wind gusts of 70 to 90 mph across much of southeast Wyoming. These high winds caused damage to vehicles and manufactured structures.

Another frequent wind occurrence in southeast Wyoming is the gap wind. These winds affect areas on the downwind side of gaps in mountains or mountain ranges, particularly the Laramie Range. Winds are funneled through the gaps by large differences in surface pressure and accelerate through the exit regions of the gaps. The most common location for gap winds is in southern Platte County to the lee of the Laramie Range near the cities of Wheatland and Chugwater, as well as the Interstate 25 exit at Bordeaux.



Inside this Issue:

Measuring Snow

By Mike Weiland

Measuring snow, especially in this part of the country, can be very difficult. Strong winds, a wet or dry snow and melting on the surface all occur at various times during the winter and make each snow measurement an adventure! To top it off, someone has to actually go out and brave the elements to try to obtain the snow measurement!

The National Weather Service and its Cooperative Observer program measure the snow at least every 6 hours when it is falling. The measurement of the snow and the corresponding liquid precipitation go into the nation's climatology and because of that are very important. Those measurements are also critical to water managers so that they can plan for the increased water usage in the summer.

So how does a person measure the snow accurately? As a start, an average of the snowfall is taken on a flat area. Those measurements are done by using a ruler (some things are not yet high tech!).

To get a snowfall amount for a given period (usually 6 hours), the snow that has fallen in a precipitation gage is melted and measured to get the liquid precipitation. This value is then multiplied by the snow to liquid ratio which is determined by the temperature. For example, if the outside temperature is 0F, then the ratio may be 30 to 1, as compared to a standard of 10 to 1. So a melted snowfall (liquid precipitation) of .10 could vary from 3 inches (at a 30 to 1 ratio) to 1 inch (at a 10 to 1 ratio).

There are currently automated methods of measuring snow, which will likely become better and more common with time. The SNOTEL sites in the mountains use snow pillows to measure the weight of the snow and the corresponding snow depth. Equipment using lasers is now being tested in Colorado which may make snow measuring more automated and accurate. Until then, measuring snow will continue to be a challenge in southeast Wyoming and the Nebraska panhandle.

A weighing rain gauge with an alter shield.

Areal Climate Summary for the Year 2011

By Rich Emanuel

The year 2011 for this region turned out to be generally a little cooler than normal. Rainfall was generally near to above normal, with some notable extremes.

The year was characterized in general by a cool late winter and spring, mild and wet conditions in the late spring into early summer transitioning to very warm and dry conditions from mid-summer into fall, then closing out closer to normal. The overall weather pattern was affected by the presence of La Nina, which was at moderate to strong strength early in the year. It dissipated for a time by summer but reappeared at weak to moderate strength in the fall.

***Temperatures*:**

Average temperatures across the region for the year turned out to be a little cooler than normal, with the central and northern Nebraska panhandle being a little warmer than normal. Much of the warmer than normal average there can be attributed to very warm temperatures in July and August. The following table summarizes the average annual temperature, average daily high and low temperatures, and the departures from normal for select sites over the area:

City	2011 Average Temp.	Departure from normal*	2011 Average High Temp.	Departure from normal*	2011 Average Low Temp.	Departure from normal*
Cheyenne	45.8	-0.5	58.2	-0.3	33.3	-0.9
Laramie	40.2	-0.7	53.7	-0.7	26.6	-0.8
Rawlins	42.2	-0.2	55.0	-0.4	29.3	-0.1
Chadron	47.5	+0.3	62.1	-0.5	32.8	+0.8
Scottsbluff	49.2	+0.4	64.0	+0.5	34.4	+0.4
Sidney	49.6	-0.5	64.3	0.0	34.9	-1.1

* based on new normals for the period 1981-2010.

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Areal Climate Summary for the Year 2011

By Rich Emanuel

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The warmest and coldest temperatures of the year and the number of days with highs 90 or higher and lows of zero or lower are depicted for select cities in the following table:

City	Highest Temperature	Date(s)	Lowest Temperature	Date	Number of days with highs 90 or above	Number of days with lows zero or below
Cheyenne	**94**	Jul 4, Aug 25	**-24**	Feb. 2	15	12
Laramie	**90**	August 25	**-39**	Feb. 2	1	34
Rawlins	**93**	July 25	**-36**	Feb. 2	12	17
Chadron	**105**	Jul 31, Aug 25	**-28**	Feb. 2	55	25
Scottsbluff	**102**	August 23	**-20**	Feb. 2	58	16
Sidney	**102**	Jul 31, Aug 23	**-19**	Feb. 2	52	14

Precipitation:

Precipitation across the area was generally near to above normal, though a significant amount of the precipitation fell in the first half of the year, with the second half somewhat on the dry side. There were some extremes of note. Sidney, Nebraska recorded their wettest summer on record as an impressive 16.19 inches of rain was recorded in June through August. Cheyenne recorded its 2nd wettest July on record with 5.63 inches of rainfall. At the other extreme was Chadron Nebraska which had a very dry summer. Only 2.48 inches recorded there. In addition, it was the driest August on record for Chadron as only a trace of rainfall was recorded in that month.

The following table tabulates the 2011 precipitation and snowfall amounts, departures from average and the percent of normal:

City	2011 precipitation	Departure from normal*	2011 Snowfall	Departure from normal*
Cheyenne	**19.25**	**+3.31 (121%)**	**68.7”**	**+8.4”**
Laramie	**10.42**	**-0.50 (95%)**	**----**	**----**
Rawlins	**9.77**	**+0.52 (106%)**	**----**	**----**
Chadron	**17.82**	**-0.23 (99%)**	**----**	**----**
Scottsbluff	**18.85**	**+3.06 (119%)**	**38.5”**	**-3.6”**
Sidney	**27.76**	**+9.22 (150%)**	**----**	**----**

* based on new normals for the period 1981-2010.

Other Notable Weather Events during 2011:

- Significant river flooding occurred in late spring into early summer due to snow melt from unusually high snowpack over the mountains.
- First severe thunderstorm event over the area occurred on May 9th over east central Wyoming and the northern Nebraska Panhandle. Hail up to 2.75 inches in diameter fell south of Chadron while a brief tornado was spotted east of Harrison, Nebraska.
- Damaging hail up to 1.75 inches in diameter fell in Sidney on June 13th resulting in many broken windows.
- Severe hailstorm struck Cheyenne on July 12th resulting in widespread damage to roofs and vehicles with hail up to 2 inches in diameter. Over 2 inches of rain fell in about ½ hour as well resulting in some flooding.
- Last severe thunderstorm event occurred on August 29th with some large hail and a brief tornado over the extreme northern Nebraska Panhandle.
- A couple of significant early season snows occurred in October. The first occurred on October 8th at elevations generally above 6000 feet. The snow was rather heavy and wet and caused tree limbs to snap and in some cases fall onto power lines which resulted in power outages, especially northwest of Cheyenne. Snowfall amounts from 3 to 8 inches were common in these areas. A second heavy snow occurred on the 25th into the 26th and produced generally 5 to 10 inches across parts of the area.
- High winds over parts of the area December 29th and 31st with gusts to 77 mph measured in Cheyenne and up to 90 mph northwest of Cheyenne. The winds caused some damage to roofs as well as blew over several trucks on roads. The winds gusts were ranked in the top 10 strongest on record for Cheyenne.

Inside this Issue:

"there are some things that you can do now to prepare. . . "

Inside this Issue:

Flood Preparedness

By Mike Weiland

Flooding was a major issue across southeast Wyoming and the western Nebraska panhandle in 2010 and 2011. Most of the flooding can be attributed to runoff from a significant snowpack in the mountains. Damage was estimated by Wyoming Homeland Security to be at $5.9 million in 2011 with $3.7 million in Wyoming in 2010. Those figures do not include road or agricultural damage. There was even unfortunate loss of life due to flash flooding in July 2011 in the Sierra Madre Range.

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. As much as 90 percent of the damage related to all natural disasters (excluding droughts) is caused by floods and associated debris flows. Most communities in the United States can experience some kind of flooding. Over the 10-year period from 1988 to 1997, **floods cost the Nation, on average, $3.7 billion annually.** The long-term (1940 to 1999) annual average of lives lost is 110 per year, mostly as a result of flash floods.

Even though it is still the winter, there are some things that you can do now to prepare yourself, family and property for the possible flooding this spring and summer. The Wyoming Office of Homeland Security has good information on flood preparedness on their website http://wyohomelandsecurity.state.wy.us/main.aspx. There is also good information from FEMA at the website ready.gov. Following is flood preparedness information from that website.

Even if you feel you live in a community with a low risk of flooding, remember that anywhere it rains, it can flood. Just because you haven't experienced a flood in the past, doesn't mean you won't in the future. Flood risk isn't just based on history; it's also based on a number of factors including rainfall, topography, flood-control measures, river-flow data, and changes due to new construction and development.

Flood-hazard maps have been created to show the flood risk for your community, which helps determine the type of flood insurance coverage you will need since standard homeowners insurance doesn't cover flooding. The lower the degree of risk, the lower the flood insurance premium.

In addition to having flood insurance, knowing following flood hazard terms will help you recognize and prepare for a flood.

To prepare for a flood, you should:

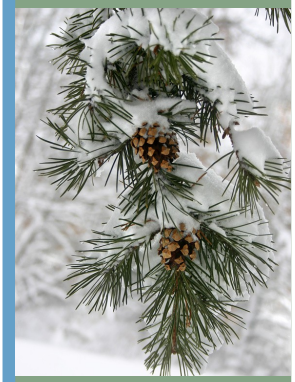
- Build an emergency kit and make a family communications plan. For move information visit www.ready.gov.
- Avoid building in a floodplain unless you elevate and reinforce your home.
- Elevate the furnace, water heater and electric panel in your home if you live in an area that has a high flood risk.
- Consider installing "check valves" to prevent flood water from backing up into the drains of your home.

If feasible, construct barriers to stop floodwater from entering the building and seal walls in basements with waterproofing compounds.

Verification of High Wind Events

By Mike Jamski

Inside this Issue:



From fall through spring, high winds are common across southeast Wyoming, with lesser occurrences in the Nebraska Panhandle. High winds are defined as sustained non-convective winds of 35 knots (40 mph) or greater lasting an hour or more, or winds (sustained or gusts) of 50 knots (58 mph) for any duration on a widespread or localized basis. In mountainous areas, the criteria are sustained winds of 43 knots (50 mph) or greater lasting an hour or more, or winds (sustained or gusts) of 65 knots (75 mph) on a widespread or localized basis. These high wind events impact public safety, transportation and commerce.

The National Weather Service in Cheyenne will issue a High Wind Watch when there is a 50 percent or greater chance of a high wind event occurring in the next 12 to 48 hours. A High Wind Warning will be issued when wind speeds are forecast to meet or exceed warning criteria, or there is a greater than 80 percent chance of a high wind event occurring.

High wind warnings are verified when wind criteria, sustained and/or gusts, are met during the valid warning period. There are a variety of data sources and networks at the forecaster's disposal to verify high wind events. These include automated surface observations, highway sensors, remote weather observations, spotter reports, emergency managers, and 911 dispatchers. To verify high wind warnings, forecasters look at the number of observations per zone. For example, if there are five sites in a zone and only one is meeting high wind criteria, that data may be questionable and not used to verify that zone. While observations are crucial to the verification process, impacts to public safety are paramount. Forecasters must use their common sense and best judgment when issuing high wind warnings, especially when high winds will cause hazardous travel. Both Wyoming and Nebraska Department of Transportation provide travel advisories and highway closure information that forecasters utilize in their warnings.

The verification of high wind warnings begins with the entry of high wind events into the NWS Storm Data program. The entries include the affected zone, start/end date/time, wind magnitude (estimated or measured, sustained or gust), event source, event narrative, damage estimate and injury/death. The data is certified by the Warning Coordination Meteorologist and official statistics on demand are calculated by the NWS Performance Branch. The statistics include the following:

Number of Warnings Issued, Verified, and Not Verified

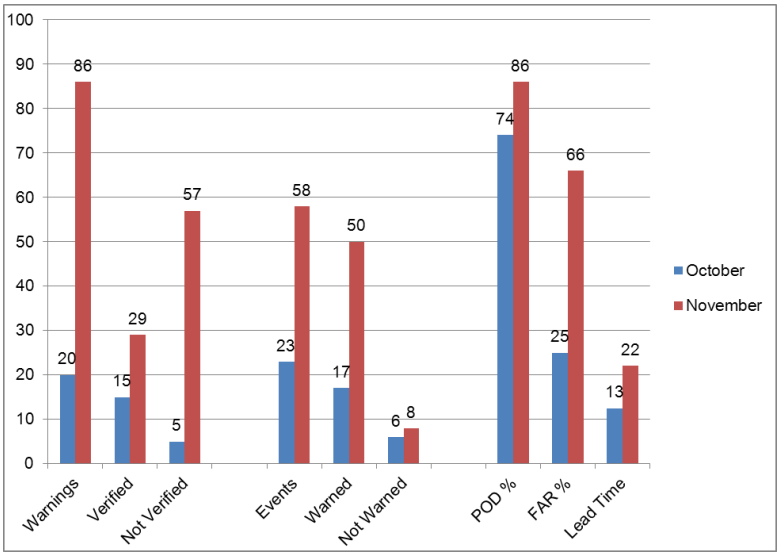
Number of Events Reported, Warned, and Not Warned

Probability of Detection (POD): Percent of high wind events warned

False Alarm Ratio (FAR): Percent of high wind warnings verified

Lead Time (LT): Average number of hours from the issuance time of the high wind warning and high wind occurrence.

For the Fiscal Year 2012 thus far (October and November 2011), the figure below illustrates NWS Cheyenne's high wind warning performance. The local goals for POD and LT are 90% and 12 hours, respectively.



This chart shows an improving trend from October to November in POD and Lead Time. The number of high wind events more than doubled and warnings increased more than four-fold in November, indicative of a very active month.

Extreme Wind Events across Southeast Wyoming and the Western Nebraska Panhandle

By Chad Hahn and Chris Hammer

The winter months often favor periods of strong and potentially damaging winds for the city of Cheyenne and surrounding areas of southeast Wyoming and the western Nebraska panhandle. The final days of 2011; however, were highlighted by two back-to-back extreme wind events which are not particularly common for the local area. These conditions were largely caused by the passing of multiple strong cold fronts, and the presence of very strong winds on the order of 70 to 90 MPH located a few thousand feet above the surface of the Earth.

The first weather system moved across the region on Wednesday and Thursday, December 29th. This was a prolonged high wind event, with some of the more wind prone areas such as Bordeaux and Arlington seeing frequent gusts in excess of 60 MPH for a period of 24 to 36 hours. These winds did not arrive in Cheyenne until shortly after sunrise on Thursday. At that time, sustained winds increased dramatically to around 55 MPH with frequent gusts in excess of 60 MPH persisting through much of the afternoon. The highest wind gust recorded at the Cheyenne airport was 77 MPH at around 3:00 PM on Thursday. High winds eventually spread east into the southern Nebraska panhandle, with Kimball, Nebraska, reporting a maximum wind gust of 62 MPH. There were minimal reports of damage as a result of the first wind event; however, the winds made for extremely dangerous travel for light trailers and other high-profile vehicles, prompting banned travel for such transportation modes over parts of Interstates 80 and 25. The following picture was taken by the Wyoming State Highway Patrol near Mile Post #4 on Interstate 25, south of Cheyenne on Thursday.

A similar storm system raked southeast Wyoming and the western Nebraska panhandle during the morning and afternoon hours on Saturday, December 31st. A relatively quiet sunrise quickly transitioned to extreme, and in some cases destructive winds as a powerful cold front swept across the region. This event was much more widespread, and was responsible for more frequent gusts in excess of 70 MPH within the city of Cheyenne. During the mid morning hours, the Cheyenne airport recorded a damaging gust to 76 MPH, with multiple reports of damage to vehicles and manufactured structures. Most notably, this included significant damage to the roof of Sam's Club on Dell Range Boulevard, and a few toppled business signs. A few minor injuries could also be attributed to the extreme winds (i.e. airborne objects), which is a good reminder of the dangers of high winds. In surrounding areas, a wind gust of 90 MPH was recorded near Chugwater, Wyoming, around sunrise on Saturday.

A composite map of maximum recorded wind gusts (in MPH) for each event is provided below, with the values color-coded to indicate significance. It must be noted that, due to the high volume of wind gust reports obtained by our office, and for better readability, these maps do not necessarily show all individual reports.

Tractor-trailer blow over along Interstate 25 near mile marker 4. *(Photo Courtesy of Wyoming Highway Patrol*)

WORLD RECORD WIND SPEED: The highest wind speed ever recorded on the surface of the Earth was 231 mph on April 12 1934, atop Mt. Washington, New Hampshire. This high-elevation weather station experienced the winds of an extremely strong jet stream that had descended unusually low in the atmosphere.

Inside this Issue:

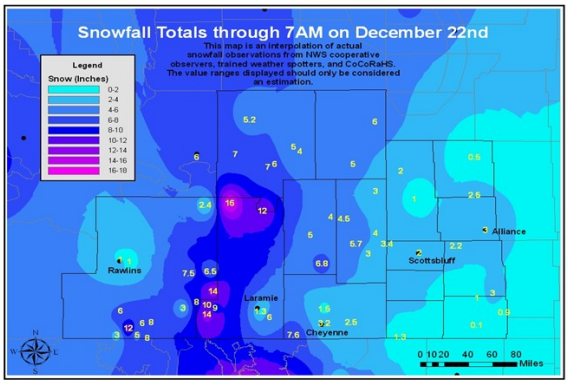
Weather, Climate and GIS

By Chris Hammer

Inside this Issue:

What is GIS?

A Geographic Information System, or GIS, is a specialized system which is used for the analysis, management, and presentation of any form of data associated with unique geographic locations. The fundamental principal of geography is that location is an important aspect in our lives, and GIS uses computers and software to visualize useful information about any given location. These visualization techniques make GIS an extremely valuable tool for data analysis, which typically aids in our understanding and interpretation of important demographic and scientific issues. There are a number of key benefits which can result from the use of Geographic Information Systems. First, GIS can be used to optimize energy and transportation systems, eventually improving their efficiency and resulting in considerable economic savings. It is also a valuable tool for decision making in many realms, including building construction, natural resource extraction, and storm evacuation planning. Similarly, GIS-based maps portray information in an easy-to-understand language which promotes efficient communication among various professional fields, organizations, and the general public.



A GIS-based map of snowfall totals across southeast Wyoming and the western Nebraska panhandle following a significant winter storm on December 22nd, 2011.

GIS Connections to Meteorology

It is well known that a large portion of meteorological information is portrayed on weather maps and charts, so there is a natural connection between meteorology and geography. The most common use of GIS in the field is the integration of real-time, forecast, and climatic information with geographic features, making it relatively easy to view and understand the placement of meteorological features and climate data for a particular location or region and allowing users to make better decisions. In a more complex example of improved decision making, historical climate data can also be combined with demographic information (i.e. population and building standards) to help develop risk assessments associated with various natural disasters, including tornadoes, hurricanes, and winter storms. This often leads to improved disaster preparedness, which in turn saves lives and countless dollars in potential damages to the local economy and infrastructure.

National Weather Service GIS

The primary uses of GIS within National Weather Service field offices include; displaying radar information, enhancing the public forecast, performing post-storm analyses on precipitation and high wind events, displaying climatological data, and enhancing hydrological information. In recent years, the National Weather Service has begun utilizing GIS techniques to revolutionize the way the public views radar products. It is now possible for users to utilize programs such as Google Earth or Google Maps to overlay accurate radar information on detailed street maps or high-resolution satellite images, giving users the opportunity to see exactly where threatening thunderstorms are located with respect to a specific position. Similarly, the detailed geographical information associated with severe thunderstorm and tornado warnings has greatly improved the dissemination of such products, with many cell phone applications providing users with a text message or phone call when their exact location is threatened by a severe thunderstorm. The polygon warnings can also be plotted on street maps, easily identifying the areas of concern and helping to lower the false alarm rate for areas near, but not included in a given severe thunderstorm or tornado warning.

In any significant weather event, the National Weather Service depends on reports from area law enforcement, trained weather spotters, and members of the general public to create an accurate depiction of the observed conditions across the forecast area. GIS software enables the National Weather Service to display these data in the form of a contour map, which provides a general overview of a given event and aids in the verification of watches, warnings, and advisories. In the climate realm, GIS gives us the ability to present typical values of monthly, seasonal, and annual precipitation and temperatures in a variety of global weather regimes. A detailed climatology can also be prepared for any type of storm event, such as high winds, hail, or perhaps tornadoes. This can be done with respect to virtually any geopolitical boundary, such as NWS forecast zones, counties, or states.